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Study on Effects of Hypoxic Pretreatment to Improve Antioxidative Capacity of Skeletal Muscle in Treating Muscle Injury of Martial Arts Athletes

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Abstract:

To investigate the effects of hypoxic pretreatment on improving antioxidative capacity of skeletal muscle and treating muscle injury of martial arts athletes, We Choose 10 male students with martial arts related specialty from Chongqing jiaotong university. The subjects were trained in a hypoxic environment under a physiological laboratory in a test center (the simulated environment was oxygen concentration of 16% with 16℃temperature and 20% humidity and test altitude of 2000m). Our result shows that the subjects had lower lung capacity, CFF in hypoxic environment and the grip strength of both hands in hypoxic environment all higher than those under quiet and normal temperature normoxic activities; subjects in the hypoxic environment, oxygen saturation was significantly lower than the normal normoxic heart rate, exhaustive exercise test duration has been shortened. Obviously hypoxic pretreatment can effectively improve the antioxidative capacity and self-repair ability of skeletal muscle.

Keywords: *Hypoxic pretreatment, Anti-curing ability, Muscle injury, Antioxidative capacity, Athletes*

I. INTRODUCTION

Chinese martial arts has a long history and very large mass base both at home and abroad; it is our cultural treasures, people usually use the “broad and profound” to describe the charm of it and it also has the rich content and theory. Most scholars support to define martial arts as the traditional Chinese sports with sports forms mainly include routines and wrestling, sport content with attack and defense and focus on the martial arts of both internally and externally Martial arts sports is inevitable to cause injury and the main clinical is muscle injury; because

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of the characteristics of martial arts, the injures mostly occurred in the limbs and waist. In recent years, the level of martial arts competition was increasing year by year, which led to many athletes in order to achieve better results to perform high training intensity of repetitive training in the weekday training and caused the above mentioned muscle injury which also means skeletal muscle damage [1-2]. In this study, we investigated the results of blood oxygen saturation, blood pressure, CK, IL-6 and other related indicators after the exhaustive exercise experiment of the subjects, and found that hypoxic environment can enhance the potential and adaptability of the body, and then infer the body oxygen movement ability [3-5].

II. MATERIALS AND METHODS

2.1 Source of Research Objects

Choose 10 male students with martial arts related specialty from Chongqing jiaotong university; at least 3 to 5 years of professional training; with age between 18-23, average age between (21.54 ± 1.60), height between 165-183cm, average height between (171.88±7.54)cm, weight between 60-78kg, average weight between (65.18±8.23) kg.

2.2 Research Methods

2.2.1 Literature method

After researching and confirming the research project, this study clarifies the current situation and progress of the previous research by reviewing the extensive literature and existing information in the relevant research field, and analyzes the existing views and discoveries; the relevant literature and data related to this project are also analyzed and summarized in order to sum the self-view and the research idea of this time.

2.2.2 Experimental method

The subjects were all walking slowly to a physiology laboratory in a test center in the morning, testing lung capacity, CFF and hands grip after 10 minutes' sedation and then doing 10 minutes' warm-up exercise. After confirming that the preparatory activities are to be well done, the training should be carried out in a simulated hypoxic environment under a physiological laboratory in a test center (the simulated environment was oxygen concentration of 16%, temperature of 16℃, humidity of 20% and test altitude of 2000m); each subject was distributed with a power bike and when the heart rate of the subject dropped to less than 80 times per minute, the exhaustive exercise test began; the initial bicycle load was 50W and when

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the speed of the bike reached 60 times per minute then increased load of 50W for each three minutes; observe the vital signs, measure blood oxygen saturation, CK, IL-6, LDH and make detailed records of vital signs monitoring results and exercise duration; making the second exhaustive exercise experiment with ordinary experimental environment (the indoor temperature of 20℃ and humidity of 15%), the subjects sit on the power bike, when the heart rate of the subject dropped to less than 80 times per minute, the exhaustive exercise test began; the initial bicycle load was 50W and when the speed of the bike reached 60 times per minute then increased load of 50W for each three minutes; observe the vital signs, measure blood oxygen saturation, CK, IL-6, LDH and make detailed records of vital signs monitoring results and exercise duration [6-7]. Repeat the experiment for every two days, and altogether carry out the experiment for fifteen times; analyze the oxygen saturation of the first and last experiments; make contrast of detailed records of vital signs monitoring results and exercise duration; analyze the skeletal muscle antioxidant function and fatigue index of martial arts athletes in order to infer the recovery of the skeletal muscle after injury [8-10].

2.3 Laboratory Apparatus

The main experimental apparatuses used in this study are as follows: (1) measurement of vital capacity, Ningbo Jiangbei Tiandikuan Electronic Products Factory, model TZCS-3. (2) CFF measuring instrument, Shanghai Yi Lian Medical Instrument Development Co., Ltd., model BD-II-118. (3) grip strength test, model CWL-I, National Sports Research Institute of Science and Technology Development Service Center. (4) automatic blood gas analyzer, model Roche Cobas b123, provided by Shanghai Xinzheng Medical Equipment Co., Ltd. (5) heart rate measurement, provided by Shenzhen Guying Technology Co., Ltd., model OXI-1418T. (6) hypoxic generator, the Australian Plateau hypoxic training instrument, provided by Shanghai Biaopu Laboratory Equipment Co., Ltd. (7) Power Bike, Germany Vertical Power Bike, Model WI45766.

2.4 Indexes of Experimental Observation

The indexes of the study included lung capacity, CFF, two-hand grip strength (calculated separately), oxygen saturation, exhaustive exercise duration, heart rate, CK, IL-6, LDH. The vital capacity detection method is:

Subjects hand-held with disposable plastic breath mouth, after one or two times more than the usual deeper breathing then suddenly breathe, hold the breath, finally exhaled slowly with the medium speed / intensity until no longer can exhale. Care should be taken to avoid as much as possible to take a deep breath action to lift the shoulders, pay attention to mouth, to avoid

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inhalation of gas waste, promoting the test results more accurate.

2.5 Statistical Analysis

This study selected SPSS18.0 software to process the data, use () to represent the measurement data, implement the test and experiment the results, when the data is lower than 0.05 which indicates that the data difference is obvious enough to obtain statistical significance.

III. RESULTS

The lung capacity, CFF, two-hands grip strength of subjects in the hypoxic environment are higher than the static and normal temperature and normal oxygen environment, see Table I: (1) in quiet state, the lung test results in the first and last experiment, t=0.0503, P=0.9604; CFF of initial experiment and the last experiment, t= 0.8191, P=0.4234; the left hand grip strength of initial experiment and the last experiment, t=1.3575, P=0.1914; the right hand grip strength of initial experiment and the last experiment, t=0.1433, P=0.8877; (2) in the hypoxic environment, the lung test results in the first and last experiment, t=0.0410, P= 0.9678; CFF of initial experiment and the last experiment, t =4.0045, P =0.0008; the left hand grip strength of initial experiment and the last experiment, t=0.5763, P=0.5716; the right hand grip strength of initial experiment and the last experiment, t=0.0247, P=0.9806;. (3) Under normal environment, the lung test results in the first and last experiment, t=0.0503, P=0.9604; CFF of initial experiment and the last experiment, t= 1.0556, P=0.3051; the left hand grip strength of initial experiment and the last experiment, t=0.4445, P=0.6620; the right hand grip strength of initial experiment and the last experiment, t=0.0270, P=0.9787.

Compare the numerical difference between the hypoxic environment and the quiet state in the last experiment: (1) vital capacity, t=3.2557, P=0.0044; (2) CFF, t=5.7953, P=0.0000; (3) the grip strength of left hand, t=3.7469, P=0.0015; (4) the grip strength of right hand, t=0.3646, P=0.7196.

Compare the numerical difference between the normal environment and the quiet state in the last experiment: (1) vital capacity, t=3.3378, P=0.0037; (2) CFF, t=2.7484, P=0.0132; (3) the grip strength of left hand, t=2.8535, P=0.0106; (4) the grip strength of right hand, t=0.6008, P=0.5554.

Table I. Subjects in different environments to test the body fatigue index changes

Detec	Quiet state	Hypoxic	Normal

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tion Indicator			**Environment**		**Environment**	
	First Experiment	Last Experiment	First Experiment	Last Experiment	First Experiment	Last Experiment
Vital Capacity (ml)	4468.23 ± 733.50	4452.10 ± 698.78	3333.54 ± 782.55	3347.85 ± 778.57	3310.85 ± 847.20	3320.22 ± 848.75
CFF(s)	23.54 ± 2.13	24.54 ± 3.22	16.55 ± 0.99	18.35 ± 1.02	20.18 ± 1.95	21.25 ± 1.99
Left Hand Grip Strength (N)	526.41 ± 45.08	554.12 ± 46.20	466.62 ± 46.52	478.32 ± 44.25	491.64 ± 38.32	499.36 ± 39.35
Right Hand Grip Strength (N)	569.77 ± 88.60	575.35 ± 85.56	589.41 ± 95.57	590.23 ± 96.60	551.35 ± 88.33	552.40 ± 85.26

Oxygen saturation and heart rate of the subjects in the hypoxic environment were significantly lower than the normal oxygen activity, exhaustive exercise test duration was also significantly shorter, see Table II: (1) under hypoxic environment, the numerical differences of the oxygen saturation of the initial experiment and the last experiment: t=1.2705, P=0.2201; the numerical differences of the heart rate of the initial experiment and the last experiment: t=0.4262, P=0.6750; the numerical differences of the exercise test duration of the initial experiment and the last experiment: t=0.1266, P=0.9007; (2) under normal environment, the numerical differences of the oxygen saturation of the initial experiment and the last experiment: t=1.0694, P=0.2990; the numerical differences of the heart rate of the initial experiment and the last experiment: t=0.1762, P=0.8621; the numerical differences of the exercise test duration of the initial experiment and the last experiment: t=0.0549, P=0.9567.

Compare the numerical difference between the hypoxic environment and normal environment in the last experiment: (1) oxygen saturation, t=5.3899, P=0.0000; (2) heart rate, t=19.5735, P=0.0000; (3) the exercise test duration, t=2.7746, P=0.0125.

Table II. The oxygen saturation, heart rate, and exhaustive exercise duration of the subjects in different environment

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Detection Indicator	**Hypoxic Environment**		**Normal Environment**	
	First Experiment	Last Experiment	First Experiment	Last Experiment
Oxygen Saturation	87.02 ± 2.65	88.54 ± 2.70	93.66 ± 2.51	94.87 ± 2.55
Heart Rate	137.50 ± 12.33	135.20 ± 11.80	33.57 ± 12.38	34.50 ± 11.20
Exhaustive Exercise Duration	710.02 ± 96.65	715.52 ± 97.63	829.33 ± 89.75	831.54 ± 90.24

IV. CONCLUSION

Many scholars believe that there is a certain phenomenon of oxidative free radicals in skeletal muscle injury, which is a hot topic in the field of related research now. In this study, the vital capacity, CFF, two-hand grip strength of the subjects in the hypoxic environment were higher than the quiet state and normal temperature and oxygen activities; the oxygen saturation of the subjects in the hypoxic environment was significantly lower than the normal temperature and oxygen activities of heart rate; the exhaustive exercise test duration has been shortened, and the last experimental data is higher than the initial experimental data, there is a difference between some data comparison, but with no statistical significant, P is higher than 0.05. However, it still shows that hypoxic training can improve the ability of anti-hypoxic of martial arts athletes, enhance their endurance, and this also shows the body's physical strengthening indirectly, which is conducive to the recovery of skeletal muscle injury as soon as possible. The exhaustive experimental content this time is the repetition of a large number of exercise, which is also the highest rate of movement that occurs of the martial arts athletes in the preparation of martial arts competition process, or daily large training volume but also the highest rate of movement which leads to the injury of the martial arts athletes; and in human trials, the test results are much easier to be restricted, such as sampling restrictions, sampling technology limitation, these can easily change the research results. It can be inferred that repetitive exercise of super-intensity can cause muscle injury of athletes, while moderate repetitive exercise can promote the gradual recovery of human function, and if you want to stimulate tissue antioxidant the drug treatment can be reached; in short, hypoxic pretreatment can be effective to help the athletes recovery as soon as possible after the injury, especially after the intensity of large sports, but the injury site of the martial arts athletes also needed to be focused and take active treatment measures to relieve pain and promote recovery.

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REFERENCES

[1] Crane J D, Ogborn D I, Cupido C, et al. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. Science Translational Medicine, 2012, 4(119): 119ra113.
[2] Lacraz G, Rouleau A J, Couture V, et al. Increased stiffness in aged skeletal muscle impairs muscle progenitor cell proliferative activity. PLoS One, 2015, 10(8): e0136217.
[3] Wang Z, Fang B, Tan Z, et al. Hypoxic preconditioning increases the protective effect of bone marrowmesenchymal stem cells on spinal cord ischemia/reperfusion injury. Molecular Medicine Reports, 2016, 13(3): 1953-1960.
[4] Fang D, Ming F, Qi G, et al. Effects of hypoxic preconditioning on the expression of iron influx and efflux proteins in primary neuron culture. Neurochemistry International, 2012, 60(4): 335.
[5] HAM Daanen. Finger cold-induced vasodilation:a review. European Journal of Applied Physiology, 2003, 89(5): 411-426.
[6] Pillon N J, Bilan P J, Fink L N, et al. Cross-talk between skeletal muscle and immune cells: muscle-derived mediators and metabolic implications. American Journal of Physiology Endocrinology & Metabolism, 2001, 280(5): E745.
[7] Israeli-Rosenberg S, Chen C, Li R, et al. Caveolin modulates integrin function and mechanical activation in the cardiomyocyte. Faseb Journal Official Publication of the Federation of American Societies for Experimental Biology, 2015, 29(2): 374-384.
[8] Ozeki N, Hase N, Kawai R, et al. Unique proliferation response in odontoblastic cells derived from human skeletal muscle stem cells by cytokine-induces matrix metalloproteinase-3. Exper Cell Res, 2014, 331(1): 105-114.
[9] Hughes D C, Wsllace M A, Baar K, Effects of aging, exercise, and disease on force transfer in skeletal muscle. Am J Physiol endocrinol Metab, 2015, 309(1): E1-E10.
[10] Leus I V, Shamelashvili K L, Skoryk O D, et al. Antioxidant and antitumor activity of dirhenium dicarboxylates in animals with guerin carcinoma. Ukrainskii Biokhimicheskii Zhurnal, 2012, 84(3): 72-81.